



ANALOG DEVICES

221 FIFTH STREET, CAMBRIDGE, MASSACHUSETTS 02142

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ANALOG UPDATE

NEWS OF NEW PRODUCTS FROM ANALOG DEVICES

Published by Analog Devices, Inc. ■ Cambridge ■ Massachusetts 02142 ■ April 2, 1970

"PRE-SELECTED OPERATIONAL AMPLIFIERS— AVAILABLE FROM STOCK"

The enclosed booklet provides data on a group of operational amplifiers that will fulfill the requirements of about 85% of the applications for which our Sales and Applications engineers are consulted. Because these amplifiers provide essentially state-of-the-art performance at better than state-of-the-economy prices, they can be considered, individually or as a group, to be today's "Best Buys." Because delivery is often as relevant a consideration as price or specs, our policy is to make every effort to carry these units in stock at all times for shipments in quantities up to 24 units.

NEW TYPES INCLUDED

Most of the types to be found in this booklet have appeared on the market within the past year, and have immediately received excellent acceptance. However, three new types having unusual significance, and even greater user value, have just been announced and are included in this Selection Guide as their first appearance. They are:

- Low Offset and Drift, ($100\mu\text{V}$ and $0.25\mu\text{V}/^\circ\text{C}$) Model 184
- Fast Settling Time, (600ns to $\pm 0.01\%$) Model 45
- Lowest-Cost FET, ($50\mu\text{V}/^\circ\text{C}$, 50pA I_{p}) Model 40 (\$12, 1-9)



FAST-SETTLING AMPLIFIER—MODEL 45

Model 45 is a FET-input differential amplifier designed for applications in which fast settling (600 ns to within 0.01%), ability to drive moderate capacitive loads, and the docile behavior inherent in 6 dB/octave rolloff are essential. Typical applications include buffer amplifiers, A/D and D/A converters, and other inverting or non-inverting applications calling



for fast, accurate response. The 0.4" height is especially important in computer system applications where tight card spacing is essential. Model 45K provides $\pm 15\mu\text{V}/^\circ\text{C}$ offset drift and 25 pA bias current for \$48 (1-9); Model 45J has $\pm 50\mu\text{V}/^\circ\text{C}$ and 50 pA for only \$38 (1-9).

LOW-COST FET-INPUT OP AMP—MODEL 40

Model 40J is an operational amplifier with FET inputs, designed to be a true "all-purpose" operational amplifier because of its low cost (\$12, 1-9) and good all-around performance: 50 pA bias current, $50\mu\text{V}/^\circ\text{C}$ offset drift, 100k typical gain (rated load), 100kHz full power output, 10k CMRR, etc. For $\pm 20\mu\text{V}/^\circ\text{C}$ drift and 20pA bias current, specify Model 40K (\$19.50, 1-9).



FURTHER INFORMATION AVAILABLE

Data sheets and application notes on the amplifier types listed in the Preselected Operational Amplifiers brochure, including the three new types listed above, are available from Analog Devices upon request. To request them, or a loaner for evaluation at no charge or obligation to buy, simply call your nearest rep (his address and telephone number are on the reverse side of this card), or the factory directly, or mail the attached postpaid Instant Action card, with appropriate notations.



LOW DRIFT CHOPPERLESS DIFFERENTIAL OP AMP—MODEL 184

Applications of low-drift chopperless amplifiers include low-level bridge circuits, transducer outputs, buffer amplifiers, and other high-precision operations on signals from sources having impedance up to $200\text{k}\Omega$. Significant specs are: $\pm 100\mu\text{V}$ offset (no offset adjustment needed for many applications), $\pm 0.25\mu\text{V}/^\circ\text{C}$ drift (millivolt signals can be measured precisely without choppers), $\pm 0.25\text{nA}/^\circ\text{C}$ bias current drift (signal sources can have reasonable impedance levels), 300,000 gain and 100,000 CMRR @ $\pm 10\text{V}$ (for accurate operation in buffer applications). And prices are low: 184J: \$45 (1-9), 184K \$60 (1-9), 184L \$75 (1-9).



C. Peter Zicko

C. Peter Zicko
Marketing Manager,
Analog Modules

ANALOG DEVICES, INC.

Representatives & Sales Offices In U.S.A. & Canada

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Alberta	see West Vancouver B.C.	
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Maritime Provs.	see Roxboro, Que.	
Ontario	1. (Eastern) Ottawa 2. (Western) Downsview	613/224-1221 TWX: 610/562-1920 416/247-7454 TWX: 610/492-2383
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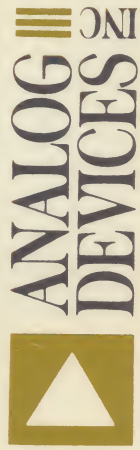
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USE REPLY CARD
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INSTANT ACTION REQUEST

I am interested in Data Sheet Evaluation "Loaner" Please send Price Quote (quantity desired)

☐ LOW-DRIFT
CHOPPERLESS

Model 184J	<input type="checkbox"/>	<input type="checkbox"/>	_____
Model 184K	<input type="checkbox"/>	<input type="checkbox"/>	_____
Model 184L	<input type="checkbox"/>	<input type="checkbox"/>	_____

☐ FAST-SETTLING FET

Model 45J	<input type="checkbox"/>	<input type="checkbox"/>	_____
Model 45K	<input type="checkbox"/>	<input type="checkbox"/>	_____

☐ LOW-COST G.P. FET

Model 40J	<input type="checkbox"/>	<input type="checkbox"/>	_____
Model 40K	<input type="checkbox"/>	<input type="checkbox"/>	_____

The following "Preselected Types"

<input type="checkbox"/> _____	<input type="checkbox"/>	<input type="checkbox"/>	_____
<input type="checkbox"/> _____	<input type="checkbox"/>	<input type="checkbox"/>	_____
<input type="checkbox"/> _____	<input type="checkbox"/>	<input type="checkbox"/>	_____

My r _____ Immediate ☐ 3-6 months

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Schooleys Mountain, New Jersey 07870

☐ Please have engineer call

(Tel. No.) (Ext.)

☐ I am interested in the following applications:

☐ Comments

☐ Please correct my address as follows:

Please remove duplicates from Analog's mailing list.
Duplicate labels are attached.



Preselected Operational Amplifiers

available from stock

The operational amplifiers featured in this short form catalog have been preselected by our applications engineering staff because, ultimately one or more of these products are recommended and used in about 85% of the applications problems solved annually by our applications engineers. Each is a proven product... value engineered to provide maximum performance per dollar available from today's op amp technology. In general, if an amplifier can be chosen from this "preselected" group the designer may specify it with the confidence that he is using a device that will not be easily obsoleted.

Preselected Operational Amplifiers

Another important factor in amplifier selection is prompt and reliable delivery. For this reason, Analog Devices has made a commitment to the maintenance of substantial stock levels of each of these preselected products. Orders are processed promptly and in nearly all cases quantities up to 24 pieces may be shipped immediately. It should also be realized that Analog Devices manufactures over 100 models of operational amplifiers, many types of function modules, and a broad line of modular power supplies, as well as A/D and D/A converters.

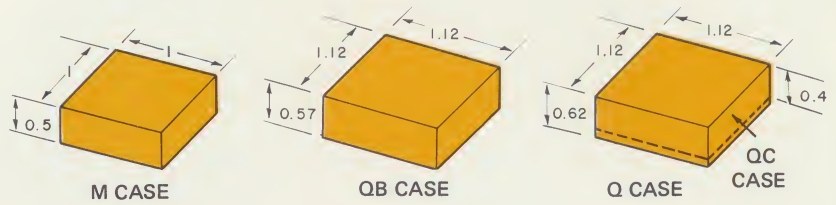
Three comprehensive catalogs are available which list detailed specifications. We will be happy to send them to you without charge upon request.

MODEL	LOW COST	
	MODEL 118	MODEL 142
	A K	A B C
All specifications typical @ 25°C and nominal supply voltage unless otherwise specified.	GENERAL PURPOSE \$11	GENERAL PURPOSE 20mA OUTPUT
OPEN LOOP GAIN		
dc, rated load, min	2.5 x 10 ⁵	8 x 10 ⁴
RATED OUTPUT, min	±10V @ 5mA	±10V @ 20mA
FREQUENCY RESPONSE		
Unity gain, small signal	1.5MHz	5MHz
Full power response, min	100kHz	150kHz
Slew rate, min	6V/μsec	10V/μsec
Overload recovery	0.5msec	1.5msec
INPUT OFFSET VOLTAGE @ 25°C, max	Adj to 0	Adj to 0
Average vs. temp 10 to 60°C, max, μV/°C	±20 ±5	±50 ±25 ±15
–25 to 85°C, max, μV/°C	±10μV/%	±75μV/%
vs. supply	±200μV/mo	±250μV/mo
vs. time	(0,+) 35nA	–50pA –25pA –25pA
INPUT BIAS CURRENT @ 25°C, max	±0.6 ±0.5	doubles every 10°C
Average vs. temp 10 to 60°C, max, nA/°C	±3nA	±10pA
–25 to 85°C, max, nA/°C	±0.1 ±0.5	doubles every 10°C
INPUT DIFFERENCE CURRENT @ 25°C		
Average vs. temp 10 to 60°C, nA/°C		
–25 to 85°C, nA/°C		
INPUT IMPEDANCE		
Differential	1MΩ	10 ¹¹ Ω 3.5pF
Common mode	1000MΩ	10 ¹¹ Ω 3.5pF
INPUT NOISE		
Voltage .01Hz to 1Hz p-p	1μV	6μV
5Hz to 50kHz rms	3μV	16μV
Current .01Hz to 1Hz p-p	20pA	0.1pA
INPUT VOLTAGE RANGE		
Absolute max. differential	±15V	±15V
Common mode voltage	>±10V	>±10V
Common mode rejection	20,000 @ ±10V	2000 @ ±9V
POWER SUPPLY	±15V @ ±4mA	±15V @ ±4.5mA
OPERATING TEMPERATURE RANGE	–25°C to +85°C	–25°C to +85°C
CASE STYLE AND MATING SOCKET	M-1, AC-1003	QB-1, AC-1003
PRICE		
1-9	\$11. \$21.	\$35. \$40. \$45.
10-24	\$10.50 \$19.	\$33. \$38. \$42.

MODEL 118
MODEL 40

MODEL 142

MODEL 180
MODEL 45



M CASE

QB CASE

Q CASE

QC CASE

FET-HIGH INPUT IMPEDANCE

LOW-DRIFT CHOPPERLESS
DIFFERENTIAL

MODEL M501		
A	B	C
MINIATURE HERMETIC FET HYBRID		

2.5×10^4
 $\pm 10V @ 5mA$

4MHz
70kHz
3V/ μ sec
0.5msec

$\pm 2mV$ | $\pm 1mV$ | $\pm 1mV$
 ± 75 | ± 25 | ± 25
 $\pm 50\mu V/\%$
 $\pm 250\mu V/mo$
-10pA | -10pA | -5pA
doubles every $10^\circ C$

$10^{11}\Omega || 4pF$
 $10^{11}\Omega || 4pF$

6 μV
6 μV
.05pA

$\pm 15V$
> $\pm 10V$
10,000 @ $\pm 5V$

$\pm 15V @ \pm 7mA$
-25 $^\circ C$ to +85 $^\circ C$
TO-8, AC1020

\$35. | \$40. | \$50.
\$33. | \$37. | \$47.

MODEL 40	
J	K
LOW COST FET \$12	

5×10^4
 $\pm 10V @ 5mA$

4MHz
100kHz
6V/ μ sec
4 μ sec

Adj to 0
 ± 50 | ± 20

$\pm 50\mu V/\%$
 $\pm 250\mu V/mo$
-50pA | -20pA
doubles every $10^\circ C$

$\pm 25pA$ | $\pm 10pA$
doubles every $10^\circ C$

$10^{11}\Omega || 3.5pF$
 $10^{11}\Omega || 3.5pF$

6 μV
3 μV
0.1pA

$\pm 15V$
 $\pm 10V$
10k, @ +8, -10V

$\pm 15V @ \pm 5.5mA$
-25 $^\circ C$ to +85 $^\circ C$
M-2, AC-1003

\$12. | \$19.50
\$11.80 | \$18.70

MODEL 146	
J	K
LOW DRIFT 2 $\mu V/^\circ C$	

10^5
 $\pm 10V @ 20mA$

5MHz
150kHz
10V/ μ sec
1.5msec

$\pm 700\mu V$
 ± 7 | ± 2

$\pm 15\mu V/\%$
 $\pm 100\mu V/mo$
-30pA | -20pA
doubles every $10^\circ C$

$\pm 10pA$
doubles every $10^\circ C$

$10^{11}\Omega || 3.5pF$
 $10^{11}\Omega || 3.5pF$

6 μV
16 μV
.1pA

$\pm 15V$
> $\pm 10V$
10k @ +5, -10V

$\pm 15V @ \pm 5mA$
-25 $^\circ C$ to +85 $^\circ C$
F-1, AC-1010

\$57. | \$70.
\$55. | \$66.

MODEL 180	
J	K
LOW VOLTAGE & CURRENT DRIFT	

3×10^5
 $\pm 10V @ 2.5mA$

1MHz
10kHz
0.6V/ μ sec
2msec

250 μV | $\pm 100\mu V$
 ± 1.5 | $\pm .5$

$\pm 2\mu V/\%$
 $\pm 5\mu V/mo$
 $\pm 4nA$
 ± 0.1 | ± 0.05

$\pm 1nA$
 ± 0.02

2M Ω
1000M Ω

1 μV
4 μV
50pA

$\pm 15V$
> $\pm 10V$
100,000 @ $\pm 10V$

$\pm 15V @ \pm 6mA$
-25 $^\circ C$ to +85 $^\circ C$
Q-1, AC-1003

\$75. | \$95.
\$72. | \$90.

MODEL 184		
J	K	L
ULTRA LOW VOLTAGE DRIFT $\pm 0.25\mu V/^\circ C$		

3×10^5
 $\pm 10V @ 5mA$

500kHz
5kHz
0.3V/ μ sec
2msec

$\pm 250\mu V$ | $\pm 100\mu V$ | $\pm 100\mu V$
 ± 1.5 | ± 0.5 | ± 0.25

$\pm 10\mu V/\%$
 $\pm 5\mu V/mo$
(0,+) 25nA
-0.25

$\pm 2nA$
 ± 0.02

4M Ω
1000M Ω

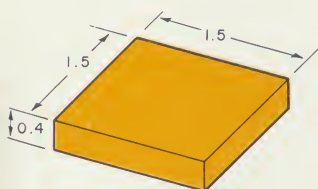
1 μV
8 μV
50pA

$\pm 15V$
> $\pm 10V$
100,000 @ $\pm 10V$

$\pm 15V @ \pm 9mA$
-25 $^\circ C$ to +85 $^\circ C$
F-1, AC-1010

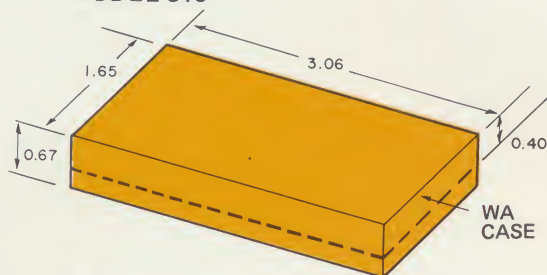
\$45. | \$60. | \$75.
\$43 | \$57. | \$71.

MODEL 120
MODEL 146
MODEL 149
MODEL 184



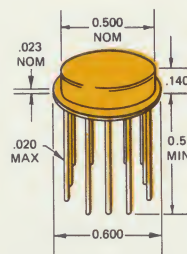
F CASE

MODEL 232
MODEL 310



W CASE

MODEL M501



TO-8 CASE

FAST SETTLING TO 0.01%

NEW

MODEL 120

A B
FAST SETTLING
.01% IN 1μsec
INVERTING ONLY

3×10^4

±10V @ 25mA

MODEL 45

J K
FAST SETTLING
.01% IN 0.6μsec
FET DIFFERENTIAL

10^5

±10V @ 20mA

MODEL 149

A B
FAST SETTLING
.01% IN 1.5μsec
FET DIFFERENTIAL

10^5

±10V @ 15mA

CHOPPER
STABILIZED

MODEL 232

J K
LOWEST DRIFT
0.1 μV/°C

10^7

±10V @ 4mA

ELECTROMETER

MODEL 310

J K
BIAS CURRENT
.01pA, max.

10^5

±10V @ 5mA

10-100MHz(Adj.)
4MHz (peak)
250V/μsec
10μsec

Adj to 0

±15 | ±8
±20μV/%
±50μV/mo
(0,+) 55nA

±0.9 | ±0.7
±4nA

±0.2

200kΩ @ dc
NA

0.5μV
3μV
100pA

±15V
NA
NA

±15V @ ±17mA
-25°C to +85°C
F-3, AC-1011

\$65. | \$75.
\$62. | \$71.

10MHz
1MHz
75 V/μsec
0.5μsec

Adj to 0

±50 | ±15
±50μV/%
±250μV/mo
-50pA | -25pA

doubles every 10°C
±25pA | ±10pA

doubles every 10°C

$10^{11}\Omega$ || 3.5pF
 $10^{11}\Omega$ || 3.5pF

5μV
3μV
0.1pA

±15V
>±10V
3000, +5 to -10V

±15V @ ±7nA
-25°C to +85°C
OC, AC-1003

\$38. | \$48.
\$36. | \$46.

15MHz
1.5MHz
100V/μsec
0.5μsec

Adj to 0

±25 | ±15
±20μV/%
±250μV/mo
-30pA | -15pA

doubles every 10°C
±10pA

doubles every 10°C

$10^{11}\Omega$ || 3.5pF
 $10^{11}\Omega$ || 3.5pF

3μV
4μV
.05pA

±15V
±10V
15,000 @ ±9V

±15V @ ±13mA
-25°C to +85°C
F-1, AC-1010

\$75. | \$85.
\$71. | \$81.

500kHz
3kHz
0.2V/μsec
(0.5μs, ext. lim.)

±15μV(Adj.) | ±10μV(Adj.)
±0.25 | ±.1

±0.1μV/%
±1μV/mo
±100pA | ±50pA
±1.0pA/°C | ±0.5pA/°C

NA
NA

300kΩ
NA

1.5μV
5μV
10pA

±15V
NA
NA

±15V @ ±3mA
-25°C to +85°C
WA-1, AC-1014

\$64. | \$99.
\$58. | \$90.

2kHz
7Hz
0.4V/msec
10msec

Adj to 0
±30 | ±10

±100μV/%
±100μV/mo
±.01pA
doubles every 7°C

NA
NA
NA

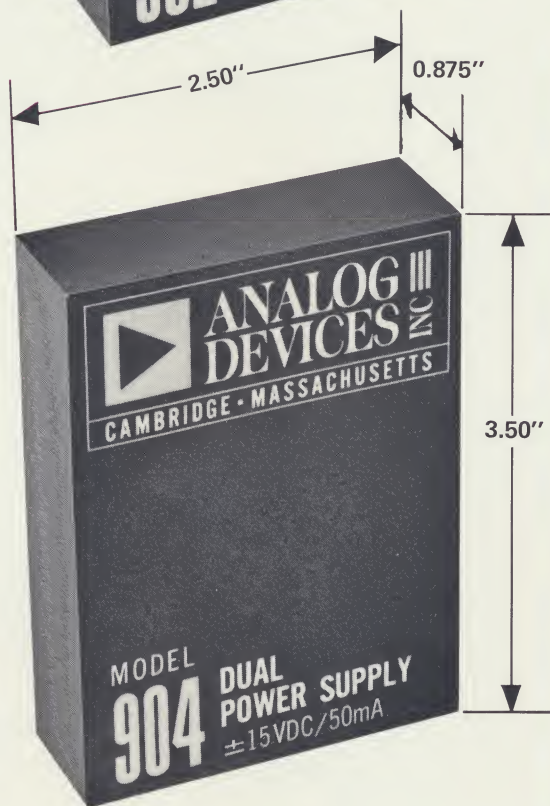
$3 \times 10^{11}\Omega$ || 30pF
NA

10μV
above 1 Hz → 1μV/√Hz
.001pA

±300V
NA
NA

±15V @ ±15mA
-25°C to +85°C
W-1, AC-1017

\$75. | \$125.
\$70. | \$113.



Power Supplies

The circuit designer's best friend these days is the packaged circuit module. Engineers everywhere have discovered the convenience and economy of "plug-in" building blocks... op-amps, logic cards, miniature D/A converters, etc. Relatively new on the scene are power supply modules. The only problem, until now, has been the cost.

ANALOG DEVICES BREAKS THE PRICE BARRIER!

Special circuit design and high volume manufacturing techniques have led to dramatic cost savings... NOW YOU CAN BUY MINIATURE POWER SUPPLY MODULES, READY TO GO TO WORK FOR YOU, AT PRICES BELOW THE INTERNAL MANUFACTURING COST OF MOST OEM USERS! You get further cost savings (and reduced lead time) by eliminating engineering start-up and manufacturing lags. Just unpack and solder into your circuit board! (Optional mating sockets are available for plug-in use). Meet your power supply requirements instantly, and with performance tested and guaranteed.

Designed by experts in op-amp and digital logic technology, these new supplies offer features (such as short-circuit and overvoltage protection) that you'd expect to find only in supplies of twice the size and cost. Ripple, noise and regulation are just right for almost all applications.

	902	904
INPUT VOLTAGE	105 to 125VAC ¹ 50 to 400Hz 17VA max	105 to 125VAC ¹ 50 to 400Hz 9VA max
OUTPUT VOLTAGE (fixed)	±15V @ 0 to 100mA	±15V @ 0 to 50mA
ACCURACY	±(15.0 to 15.3)V -15V within ±1% of +15V	±(15.0 to 15.2)V -15V within ±½% of +15V
TEMP COEFFICIENT	0.015%/°C max	0.03%/°C max
REGULATION		
Line (105 to 125VAC)	0.05% max	0.1% max
Load (0 to 100%)	0.1% max	0.1% max
WARM UP DRIFT	±0.3% (45mV)	±0.25% (37mV)
RIPPLE	0.5mV rms, 2mVp-p max	0.5mV rms, 2mVp-p max
OUTPUT IMPEDANCE	2 ohms @ 10kHz	0.2 ohms @ 10kHz
SHORT CIRCUIT PROTECTION	Any combination of output pins indefinitely 0 to 70°C	Any combination of output pins indefinitely 0 to 70°C
OPERATING TEMPERATURE	0 to 71°C derate 5mA/°C above 60°C derate 1mA/°C below 15°C	0 to 71°C derate 2mA/°C above 55°C derate 0.5mA/°C below 10°C
STORAGE TEMPERATURE	-25 to +85°C	-25 to +85°C
SURFACE TEMPERATURE RISE	20°C above ambient @ full load	25°C above ambient @ full load
INPUT ISOLATION	50 Megohms	500 MΩ 100pF
WEIGHT	16 oz.	10 oz.
PRICE	1-9 \$49 10-24 \$47	\$39 \$38

1. Input voltage of 205 to 240VAC available. Specify Model 902E or 904E. Mating Socket AC1013 \$3.50

Related Products

The products listed below are other popular models in the Analog Devices broad product line. For the most part they are variations of the preselected amplifiers in which certain performance parameters have been optimized. Since stock levels vary, please consult the factory or your local sales office for up to date delivery information.

MODEL	183J	153J/K	501A/B	231J/K	119A/K	165A/K
	LOW DRIFT LOW COST DIFFERENTIAL	BATTERY OPERATED LOW DRIFT	MINIATURE EPOXY FET HYBRID	CHOPPER STABILIZED ±25mA OUTPUT	GENERAL PURPOSE ±20mA OUT	GENERAL PURPOSE ±20V OUTPUT
OPEN LOOP GAIN, min.	200,000	50,000	25,000	10 ⁷	500,000	250,000
RATED OUTPUT, min.	±10V @ ±5mA	±1V @ ±1mA	±10V @ ±5mA	±10V @ ±25mA	±10V @ ±20mA	±20V @ ±5mA
FREQUENCY RESPONSE						
Unity gain, typ.	0.5MHz	150kHz	4MHz	0.5MHz	1.5MHz	1.5MHz
Full power, min.	5kHz	5kHz(pk)	70kHz	3kHz	100kHz (inv.)	50kHz (inv.)
Slew rate, min.	0.3V/μs	20V/ms	3V/μs	0.2V/μs	6V/μs (inv.)	6V/μs (inv.)
OFFSET SENSITIVITY, (10 to 60°C)* max.	±5 μV/°C	5/2μV/°C	75/25μV/°C	0.25/0.1μV/°C	20/5μV/°C	20/5μV/°C
BIAS CURRENT 25°C, max.	(0,+) 40nA	±3nA	±25/10pA	±100/50pA	(-0) +35nA	(-0) +35nA
vs. temp, (10 to 60°C)* max.	±0.5nA/°C	±0.1nA/°C	2.5/1pA/°C	1/0.5pA/°C	0.6/0.5nA/°C	0.6/0.5nA/°C
INPUT IMPEDANCE, Differential, typ.	2MΩ	1MΩ	10 ¹¹ Ω	300KΩ	1MΩ	1MΩ
CMRR	10 ⁵ (±10V)	50,000 (±1V)	10,000 (±5V)	NA	20,000 (±10V)	20,000 (±20V)
CASE STYLE AND MATING SOCKET	F-1, AC-1010	F-1, AC-1010	.6 x .6 x .25"	WA-1, AC-1014	F-1, AC-1010	M-1, AC-1003
PRICE (1-9)	\$35	\$40/50	\$30/35	\$80/115	\$24/34	\$24/34

*Note: Model numbers which include suffix A,B,C, or D are guaranteed over -25°C to +85°C

Typical @ 25°C and nominal supply voltages unless noted otherwise. Complete specifications, outline drawings, and application notes are listed on the product data sheets, available upon request.

How May We Help You Further?

Might we suggest a visit by one of our sales engineers? They have all been trained to provide professional engineering assistance in the various applications of our broad product line.

Alternatively, we would like to extend to you an invitation to phone (collect) to our applications engineering staff in Cambridge. This team of experts maintains extensive files on literally thousands of circuit designs, and the

answer to your specific design problem may actually be as near as your phone.

Last but not least, we take great pride in the high calibre of technical literature which we publish. Detailed data sheets, application notes and comprehensive catalogs are all yours for the asking.

We invite you to make use of these free services. Simply fill in the enclosed "Instant Action" card and mail.

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